DATA ACQUISITION SYSTEM (DAS) SPECIFICATION

1.0 REQUIREMENTS

1.1 The Data Acquisition System (DAS) to be furnished shall be used to acquire and analyze data during the Virginia Class Submarine sea trials. The data to be acquired and analyzed will be taken from uniaxial weldable strain gages, foil strain gage rosettes, LVDT displacement transducers, thermocouples, resistance temperature devices, and high-level transducers. The breakdown of channels is as follows:

- 415 strain gage channels
- 65 displacement transducer channels
- 20 high level transducer channels
- 5 thermocouple channels

The system will consist of hardware to collect gage and transducer signals, software for data collection and analysis, cabling and associated equipment for use with user supplied laptop computers, and cabinets for housing hardware.

1.2 System Arrangement - The system will be arranged into three (3) locations designated as Location 1, Location 2, and Location 3. Each location will consist of equipment firmly secured into one or more cabinets of three (3) different specified sizes. Cabinets of particular sizes will be designated as Cabinet A, Cabinet B, and Cabinet C. Cabinet specifications (including size) are described in Section 1.6. The instrumentation locations will consist of the following:

1.2.1 *Location 1* - One (1) Cabinet A containing 155 strain gage channels, 45 displacement transducer channels, 5 thermocouple channels, 10 high level transducer channels

1.2.2 *Location 2* - One (1) Cabinet B and one (1) Cabinet C containing 110 strain gage channels and 20 displacement transducer channels

1.2.3 *Location 3* - One (1) Cabinet B and one (1) Cabinet C containing 150 strain gage channels and 10 high-level transducer channels

1.2.4 Location 1 and Location 2 will be located approximately 100 feet apart from each other with a single PC laptop based control location at Location 1. The Data Acquisition units at Location 2 must be "daisy-chained" to the units at Location 1 to allow for seamless integration of data during testing. Location 3 will be a "stand alone" data acquisition location with its own PC based laptop control.

1.3 System Characteristics - The Data Acquisition System shall possess the following characteristics:

- Operation on 115 VAC
- Scan rate of greater than 30 scans per second per channel for a 350 channel system
- Capability of automatic channel detection and configuration
- Capability of internal or manual shunt calibration
- Automatic zero determination for each channel
- Manual scaling option
- Before acquiring data, system should check channels for unzeroed/

uncalibrated channels, off scale readings, and missing channels
- System should detect any hardware errors while scanning
- Manual recording option should be available during data scanning

1.4 The Data Acquisition Hardware shall possess the following characteristics:

1.4.1 *Strain Gage and RTD Hardware*:
- Excitation voltages should be settable to 1, 2, 5, and 10V
- Gain should be programmable to implement full-scale input ranges of 1, 2, 5, and 10 V
- Hardware should include software-controlled internal bridge resistance resistors for 120 ohms and 350 ohms
- Low-pass filter frequency between 4 Hz and 10 Hz
- Compatibility with 9-pin D-sub connector
- Must accept input from Resistance Temperature Detectors (RTD's) and come with software options appropriate for such devices

1.4.2 *LVDT (Displacement Transducer) Hardware*:
- Gain should be programmable to implement full-scale input ranges of 1, 2, 5, and 10 V
- Should include availability of reference excitation for calibration
- Low-pass filter frequency between 4 Hz and 10 Hz
- Compatibility with 9-pin D-sub connector
- Should be compatible with RDP Electrosense *DCT* and *D2* series LVDT transducers

1.4.3 *Thermocouple Hardware*:
- Must provide programmable cold junction reference
- Compensation must be provided for K-type thermocouples
- Low-pass filter frequency between 4 Hz and 10 Hz

1.4.4 *High Level Transducer Hardware*:
- Excitation voltages should be settable to 1, 2, 5,10, 20 and 30V
- Gain should be programmable to implement full-scale input ranges of 1, 2, 5, and 10 V
- Low-pass filter frequency between 4 Hz and 10 Hz
- Compatibility with 9-pin D-sub connector

1.5 The Data Acquisition Software shall possess the following characteristics:
- Windows based
- Password protection of Project Files
- Each Project File must be capable of storing sensor and materials data, raw and reduced test data, hardware and display settings, and user defined channel assignments
- Software should be capable of data analysis of signals from uniaxial strain gages, strain gage rosettes, resistance temperature devices, thermocouples, LVDT's, and high-level transducers
- Software should include database for common materials (including Elastic Modulus, Poisson's Ratio, and Yield Point) in English Units and the option to add custom materials as needed

- Software should be capable of creating and storing a master sensor database
- Parameters which must be software configurable offline or online include Excitation, Gain, Balance, Filter, Calibration, and Cold Junction Compensation
- System must be capable of recording data in the following manners: Manual, Continuous, Intermittent, and Limit-Based (greater than or less than a value or between two values)
- Software should permit choice of internal or manual shunt calibration and warn of large calibration errors
- Software should warn of off scale or large unbalance conditions and large calibration errors
- Software should include choice of manual scaling
- Software should warn for unzeroed/uncalibrated channels, off scale readings, and missing channels after system check
- Minimum display update rate should be 5/sec
- Recorded raw data should be available for viewing offline
- Data display should be offered in numeric and graphical form
- System should be able to show up to 48 displays on screen at one time
- User selected channels should be available for monitoring in fully reduced numeric or graphic formats during on-line monitoring
- Software should allow exporting data as ASCII, MS Word, Excel, or Access files
- Software should be able to make strain gage error corrections for thermal output, gage factor temperature correction, leadwire attenuation, transverse sensitivity, and Wheatstone bridge nonlinearity
- Software should be capable of reducing rosette data into principal stresses, strains, and angles; and shear stresses and strains
- Software should be capable of showing stresses as percent of yield stress and using common failure criteria (e.g. Rankine, Von Mises, Tresca)
- Software should be capable of thermocouple linearization
- Software should be capable of plotting data versus time or record number. User should be able to choose specified records for reduction
- Graphical displays should be exportable to bitmap/jpeg formats
- Software should be capable of producing animated charts to play back data
- Test set-up information and display settings should be able to be saved and reused for subsequent testing
- Software should include on-line help system
- All software must be currently existing and in use in current commercial applications

1.6 The Data Acquisition System shall be furnished with steel cabinets which allow access to switches and connections. The cabinets shall be of the following outside dimensions (in inches):

- Cabinet A (referenced above) will be 22 wide x 67.25 high x 24.5 deep
- Cabinet B (referenced above) will be 19.75 wide x 18.25 high x 18 deep
- Cabinet C (referenced above) will be 19.75 wide x 11.5 high x 18 deep

2.0 PACKAGING REQUIREMENTS

2.1 Electrical equipment shall be contained in plastic covering to ensure freedom from outside contaminants. Electric components which are vulnerable to damage from static electricity shall be wrapped in anti-static packaging. All electronics shall be packed in a protective case or a buffering material to prevent damage from accidental dropping or bumping. Electronic components shall come individually wrapped apart from cabinets. Cabinets shall be shipped assembled.

3.0 SHIPPING INSTRUCTIONS

3.0 All items relating to this purchase order shall be shipped to:

Electric Boat
Dept 425 Station D11-2
75 Eastern Point Road
Groton, CT 06340-4989
Attention: George Mowell

4.0 DELIVERY

3.1 The Data Acquisition System specified herein shall be delivered within 30 days after the date of order.